

Preservation of Fruits and Vegetables by Freezing

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FREEZING affords one of the simplest methods of preserving foods.

With the rapid rise in the production of frozen fruits and vegetables, there has developed a demand for more information on packing, freezing, and storage of these products. Although this method of preservation is rather simple, there are a few fundamental rules that should be followed if preserving foods by freezing is to be successful.

Too much emphasis cannot be given the fact that fresh fruit or vegetables used for freezing should be of the highest quality and as maturity affects the flavor, the stage of maturity should be watched. Green or over-ripe fruit should not be used because the products will be flavorless when "defrosted". Over-maturity in vegetables will mean a very tough and stringy product, the flavor and appearance changing with age. The best stage of maturity for eating or other use in the fresh state is also the best condition for freezing purposes.

TEMPERATURE FACTORS

Freezing temperatures for fruits and vegetables. As the result of research to determine the best temperatures for freezing fruits and vegetables, conclusions thus far reached have shown that temperatures ranging from 5° below zero to 10° above zero Fahrenheit are satisfactory for small containers. If conditions of freezing can be maintained at zero Fahrenheit during the entire freezing operation, satisfactory results will be obtained.

Storage temperatures. Although a freezing temperature also can be used for storage conditions, this is not always necessary or advisable. Temperatures not to exceed 15° above zero Fahrenheit can be used for storage, but if the locker rooms are held at zero to 10° above, they will serve both to freeze and to store products such as fruits, vegetables, meats, and fish.

It has also been learned that sugar in solution not only improves the product but assists in keeping down oxidation by completely covering and protecting the fruit to be frozen. Relationship of fruit to sugar is designated 3 + 1 or 3 to 1, meaning 3 parts of fruit to 1 part of sugar.

Uniformity of temperature is very important in storage and freezing rooms, very high outside temperatures occasionally affecting products stored in cartons or wrapping paper. Fans frequently are necessary in freezing rooms to maintain uniform conditions throughout, especially during hot periods in the summer. Lack of adequate insulation allows warm air to leak in but with fans the cold air is prevented from settling.

The process of thawing and freezing is conducive to mold growth and the development of unpleasant flavors, and should be carefully guarded against.

GENERAL METHODS OF PREPARATION

Containers for storage. There are numerous types of containers that can be used satisfactorily for storage. Tin cans of No. 2 and No. 2½ size, as well as large 5- and 10-pound cans frequently are used for institutional purposes. For home use glass jars and paraffined paper cups are suitable. For asparagus, beans, and many other products, parchment-lined waxed boxes are employed successfully and can be obtained in most of the sizes desired. For those products that oxidize rapidly, tight containers are preferable and when possible, storage in vacuum-packed cans is very satisfactory. To obtain conditions similar to vacuumizing the product can be covered with sirup or brine, thus preventing direct contact with air in the container.

Blanching vegetables. Blanching, a process of partly cooking and softening the vegetable for freezing, is essential in the preparation of most vegetables as it aids cleansing and partly saturates the product with water. This process does not actually "set" the color as has often been supposed, yet it drives off the air, producing a more brilliant color characteristic of the particular vegetable.

Another use of the blanch, and possibly the most important one, is to stop enzymatic (fermentation) reactions that cause color and decomposition changes. If the enzymes (organic bodies causing fermentation) are permitted to proceed unmolested, breakdown occurs very rapidly that ultimately destroys the product, such activity frequently taking place when foods are frozen. Blanching is important to check the work of these organisms.

Sugar and salt. Sugar can be used in two ways, dry or in solution. When used dry, the sugar should be fairly well distributed over the product, this method partly controlling oxidation when applied to berries such as strawberries, red raspberries, loganberries, and being particularly effective with fruits such as apricots and peaches.

Sugar solutions preferably are made hot and then cooled before being applied to the fruit. Densities are determined on the basis of weight with the "Balling" or "Brix" hydrometer. To make up a given density solution, for instance a 50° Balling solution, use 50 pounds of sugar to 50 pounds of water. A 60 per cent solution is made with 60 pounds of sugar and 40 pounds of water. Reduced to their lowest terms this would be 1 to 1 and 3 to 2 for quantities suitable for small packages. As sugar and water weigh almost the same on a volume basis, it has been customary in home operations to use the volume method, but for other purposes the hydrometer is used to correct the solution.

Salt solutions also are made on a weight basis. To determine the amount of salt or sugar to use, simply consider the per cent to indicate weight in parts per hundred.

Filling the containers. Do not overfill the container as it is necessary to allow enough space for the liquid and products to expand during freezing. Usually with a liquid fill not vacuumized, $\frac{1}{2}$ to 1 inch space gives good results. For glass containers not vacuumized the lids should be left loose until the content is frozen and then tightened after freezing to prevent surface oxidation.

Packing vegetables. Vegetables can be packed either well drained or with brine. The use of brine is extremely advantageous in some cases because it protects the product from the air as in the case of sirup solutions.

Rapid freezing. It is important to prepare, pack, and freeze the products quickly. Rapid freezing not only prevents color changes, but also improves and retains the important flavors of the food. Freezing the food promptly after preparation prevents changes that might occur in all handling processes.

Cooking frozen products. Those persons who have never tried frozen products frequently cook them too long. Products that have been frozen are much more tender and therefore will become soft more quickly. Usually they are ready to use with about half the normal cooking for the fresh product.

For vegetables that have been frozen without brine, the water for cooking should be brought to a boil first and the frozen vegetables plunged in and allowed to boil until soft.

Vegetables frozen in brine should be allowed to thaw, then drained, and the same brine used for cooking them. Draining, however, is not essential. The product can be placed in a pan on the stove, allowed to thaw, and then boiled, all in one process.

SPECIAL METHODS OF PREPARATION FOR FRUITS

BERRIES

Blackberries. Many varieties of blackberries are available in Oregon. The wild Evergreen is a large, succulent berry and is delicious for pies, jellies, or jams. The small wild blackberries, however, are preferred for these purposes. The domesticated varieties such as Himalaya and Oregon Evergreen are preferred for dessert purposes (uncooked).

The berries are prepared by careful sorting and washing. Berries with red drupelets—caused by a mite infestation—should be removed as the pack is very uneven in appearance if these berries are permitted to remain. For the best results, pack the fruit with either dry sugar 3 to 1 or with 50-per-cent sirup. Use paraffined cups, glass jars, or enamel-lined tin cans.

Blueberries. Blueberries grown in the Northwest probably afford one of the best berries for freezing. When defrosted, this fruit has a very natural appearance. Some of the outstanding varieties are the Rubel, Rancocus, Grover, Sam, Harding, Pioneer, Cabot, and Adams.

In preparing the blueberries for freezing they should be thoroughly screened, sorted, and washed before being packed. The fruit can be packed in paraffined cups, glass jars, or enamel-lined tins. Cover with a cold 50-per-cent syrup, seal and freeze.

Cranberries. In Oregon, the McFarlin, Howes, and Centennial cranberry varieties are grown, principally along the coast. These berries freeze well and produce a very suitable product for future use.

Select the riper and more highly colored berries. After sorting, wash carefully and pack, using paraffined cups, glass jars, or enamel-lined tins. Due to air pockets these berries are very light and the use of heavy sirups causes the fruit to float, making packing difficult. Barely cover the fruit

with sirup of 50-per-cent density. Cranberries may be frozen without sugar or sirup.

Loganberries. The loganberry is well adapted to freezing, ripe, firm berries being best. Wash the fruit carefully and pack in paraffined cups, jars, or enamel-lined tins. Dry sugar at the rate of two parts fruit to one part sugar can be used and care should be taken to cover the fruit well. If sirup is used, a 50- to 60-per-cent density will be found best. Because of the tartness of the fruit some people like the loganberry with even more sugar.

Black raspberries. The varieties grown in Oregon are the Plum Farmer, Cumberland, Munger, and Gregg. None of these varieties makes a very desirable product owing to the extremely seedy character of the fruit. Packed properly, however, they can be frozen for pie, jam, or dessert purposes. Irrigated berries of these varieties are to be preferred. Only well-filled, plump, succulent fruit should be used. Harvest at the ripe stage before the berries begin to become dry. Sort the fruit carefully and wash in fresh cold water.

Pack into containers and cover with dry sugar, three parts fruit to one part sugar. The berries are preferred when packed in a 40- or 50-per-cent cold sugar syrup because they are less dry. They can be frozen in paraffined cups, glass jars, or enamel-lined tins as desired.

Red raspberries. The Cuthbert, Lloyd George, Viking, and other raspberry varieties are suitable for freezing. Red raspberries make one of the best frozen berries, because they hold their flavor well. They should be picked when still firm but full-flavored and sweet. If harvested in a clean manner, washing is not always necessary. Rinsing in cold water tends to plump the berries and removes the dust.

Pack with either a 3 to 1 dry-sugar mixture or with sirup of 50-per-cent density. Paraffined cups, glass jars or enamel-lined tins can be used. Vacuumizing the tins aids in controlling oxidation.

Strawberries. The Marshall, Corvallis, Clark Seedling, and other strawberry varieties can be frozen very satisfactorily. The fruit should be picked when well colored and ripe but not soft. Cap and wash, and then pack in containers with a 3 to 1 dry-sugar mixture, or a sirup of 60-per-cent density. Usually the sirup pack looks the best, but if properly done the dry-sugar pack has possibilities. When the cans or jars are vacuumized, the appearance of the final dry sugar pack is greatly improved. If a dry-sugar pack is used, paraffined cups can be employed for storing.

Youngberries. Acreage of the Youngberry, a new berry for Oregon, is gradually being increased. It is a mild-flavored, large berry that is very well adapted to freezing. It can be handled exactly like the loganberry, but when packed with dry sugar the ratio should be changed to 3 to 1. A density of 30 to 40 per cent for syrup seems heavy enough. Use only enamel-lined tins, glass jars, or paraffined cups.

CHERRIES

Black cherries. The varieties of black cherries preserved by freezing are the Black Republican, Bing, and Lambert, outstanding varieties grown in Oregon. The Tartarian is grown but not on a commercial scale.

Use only well-ripened fruit that has been carefully sorted. Stems may be left on or removed. Wash the fruit before packing. The sirup pack seems the best for black cherries, concentrations of 40 to 50 per cent being satisfactory. Pack the fruit in paraffined cups, glass jars, or enamel-lined tins. Use of the vacuum in packing is helpful in retaining the natural flavor and color but it need not be resorted to for home-packed material.

Sour cherries. The Montmorency is one of the best sour cherries for freezing, although such varieties as the Early Duke, and others, can be used.

Use only bright red, tree-ripened fruit with a slightly acid taste. Wash, stem, pit, and sort carefully; then pack the fruit in paraffined cups, glass jars, or enamel-lined tin cans. Use dry sugar at the rate of 5 to 1 or cold sirup of 60-per-cent density.

White cherries. The Royal Anne is one of the best-known varieties of white cherries. Pick Royal Annes at the best eating stage when the fruit is well matured but crisp. Stem, wash, and sort; then pack in paraffined cups, glass jars, or plain tin cans. For the best results cover with a cold sirup of 40- to 50-per-cent density.

OTHER FRUITS

Apricots. The Tilton and Blenheim apricot varieties seem to be well adapted to the freezing method of preservation, and although other varieties may be used, these usually give the best results. Apricots are in best condition for freezing when firm and ripe, showing good color and maturity. Soft fruit is to be avoided because freezing contributes to loss of firmness.

Keep the fruit cool and handle it quickly. Avoid bruising. Wash the fruit carefully, then halve and pit. For home preparation sizing or grading is not necessary, but for commercial packing is essential. Peeling is not necessary and the skins help to hold the halves more firmly together. If peeling is desired, however, the fruit can be dipped in boiling water and subjected to steam or lye, as practiced in commercial canning. In case lye has been used, the fruit should be rinsed in a weak citric-acid bath.

After preparation pack the fruit with sirup in air-tight containers. Vacuum packing is recommended, but fruit packed in non-vacuum glass or tin containers, and carefully sealed, will produce a good product for home use. If tin cans are used, enamel-lined tins are preferable. Sirup densities may vary from 40 to 50 per cent. For a 40-per-cent sirup use 4 pounds of sugar to 6 pounds of water; for a 50-per-cent sirup use equal parts of sugar and water. For this pack dry sugar is not as satisfactory as sirup.

Figs. Although few figs are grown in Oregon, there seems to be a desire to preserve figs by freezing. Experiments show this can be satisfactorily done. Figs should be harvested when ripe. Care must be taken to prevent sour or rotten figs from entering the pack.

Wash and sort carefully, removing the stem up to the base of the fig. Pack the fruit, without peeling, in paraffined cups, glass jars, or enamel-lined cans. Use the dry pack or sirup with a density of 35 per cent. In most cases the sirup pack will be found the best.

Grapes. Many of the popular varieties of grapes can be frozen. Tokey, Concord, Muscat, and others are suitable. Maturity is essential to obtain full flavor. Wash, sort, and stem carefully, placing the fruit in glass jars

or enamel-lined tins. Cover the grapes with a sirup of 40-per-cent density, seal tightly, and freeze.

Peaches. Usually many varieties of peaches are available for freezing, such varieties as the Slappey, J. H. Hale, Elberta, Crawford, and others being used. Rapid handling is necessary because this fruit oxidizes readily. New varieties resistant to oxidation are being developed and soon may be made available.

When selecting peaches, choose only those of high quality with predominant flavor. The fruit should be firm and ripe. Handle it quickly by peeling with steam or hot water. If lye is used be sure to dip in water acidified with citric acid to prevent browning. Cooling is important because it delays the oxidation processes. Sliced peaches are very much better than halves but require more care. Use only airtight containers such as tin cans or glass jars, the enamel-lined tin being preferred. Vacuum packing is advantageous in preventing browning. Pack in a sirup with a density of 50 per cent and freeze quickly.

Prunes. Italian prunes, tart variety, and Petite or French prune, sweet variety, are the most commonly known for freezing processes.

Harvest while still firm, well colored, and highly flavored. These varieties can be packed whole or pitted. The Italian variety is easily pitted, and is best for this method of packing. After washing and pitting pack the fruit in glass jars or enamel-lined tins with sugar sirup of 40- or 50-per cent density, sealing the containers tightly.

SPECIAL METHODS FOR PREPARATION OF VEGETABLES

Asparagus. Frozen green asparagus when properly handled has been found satisfactory. Careful sorting is essential to obtain good, succulent, and tender stalks. Prepare and pack quickly to avoid shrinking or shriveling, blanching for 2 to 3 minutes in boiling water and then chilling quickly in cold water. Pack and seal in airtight containers without further treatment. If the brine pack is desired containers that will not seal tightly can be used. A 2-per-cent brine is preferred.

A temperature of 20° below zero Fahrenheit has been found satisfactory for freezing but higher temperatures can be used. Store at temperatures not exceeding 15° above zero Fahrenheit.

Green and wax beans. The Kentucky Wonder, Refugee, and Blue Lake are the most popular varieties of beans grown. Wax beans have been found quite suitable for freezing. Beans should be harvested while still tender. Snip, wash and blanch for 2 to 3 minutes. Dip the lot in cold water and chill quickly, then pack "asparagus style" in cans or glass jars, or in packages well waxed and wrapped. The use of wax-tight parchment wraps, finally sealed, probably affords as good a way of packaging as can be found.

Lima beans. Succulent, green Lima beans offer possibilities to those interested in freezing vegetables. They should be harvested while still young and tender, shelled, and then blanched in boiling water for 2 or 3 minutes. Packing is made in containers without brine, using glass, tin, or paraffined cups sealed without vacuum.

Broccoli. Broccoli has been frozen with unusual success, the product never losing its characteristic fresh and beautiful green color. Its attractiveness in the frozen state appeals to the housewife.

Use only the tender stalks with compact heads, sorting carefully and cutting back the stems to that part which is tender. Pack in a form so that rehandling will not be necessary after freezing and thawing. Blanch in boiling water 3 or 4 minutes and cool in fresh rinsing water.

Broccoli can be packed in packages similar to those indicated for beans. This type of packaging seems most suitable, although plain cans may be used.

Cauliflower. Cauliflower can be frozen after being carefully trimmed. Remove all the green leaves and cut the larger curds apart, then soak for a short time in a weak brine solution. Blanch in boiling water for 2 or 3 minutes, cooling promptly and packing immediately.

This product can be packed in either air-tight containers or paraffined packages well wrapped to prevent moisture loss. Freezing in 2-per cent brine solution will give good results, but dry packing is satisfactory.

Sweet corn. Freezing corn either on or off the cob has been found very satisfactory. When frozen Golden Bantam, Golden Bantam Cross (Hybrid), Stowell's Evergreen, and other varieties have proved delicious and more like the natural fresh corn than the same product preserved in other ways. Harvest when the corn is at the right stage of maturity, still in a slightly milky stage and tender.

If ears are not husked, blanch in boiling water for at least 6 minutes; if husked, blanching need not exceed 3 to 4 minutes. Pack the corn on the cob, with the husks, in paraffined boxes, tightly wrapped with waxed paper. It is desirable the boxes should also be lined with parchment paper. Corn on the cob may be packed in tin cans of either sealed or friction-top style. Large slip-cover cans holding from five to 10 ears are satisfactory. For corn off the cob, simply cut the corn off but do not scrape the cob, then place in cans or glass jars as desired and seal tight.

Mushrooms. According to some investigators mushrooms offer possibilities for freezing. The small button-sized mushrooms are found better for this purpose. Care must be taken in handling so as not to damage the caps lest discolorations appear.

Sort, size if necessary, and wash carefully, then blanch the mushrooms in boiling water for 2 to 4 minutes, depending on size, and cool rapidly. Packing is done preferably in airtight containers if the dry-pack method is used. Use of a 2-per-cent brine for packing will improve the color.

Peas. The large-size garden peas of the Alderman, Stratagem, or Telephone varieties can be used. They should be picked at the tender, succulent stage when best suited for table use. Hull, wash, and blanch them in boiling water for $\frac{1}{2}$ to $1\frac{1}{2}$ minutes, cooling quickly in plenty of fresh water. The peas can be packed dry or in brine of 2-per cent density. Seal in glass jars, tin cans, parchment-lined wax packages, or paraffined cups. Jars or cans are preferred.

Spinach. Although somewhat difficult to handle, spinach makes a very fine frozen product. Care must be used to see that the spinach is not too far advanced in maturity. It should be well washed to remove all sand and grit. Blanching is done in boiling water for 2 to $2\frac{1}{2}$ minutes. Rinse well in cold water, drain, and pack without added liquid in glass jars, cans, parchment-lined, paraffined, or waxed packages.

Table 1. FROZEN FRUIT PACK TABLE.*

Kind of fruit	Method of preparation	Type of container	Method of packing
<i>Berries</i>			
Blackberries.....	Sort, wash, and pack.	Glass jars, enamelled tin cans, or paraffined cups.	Dry sugar 3 to 1 or 50° Balling sirup to cover fruit.
Blueberries.....	Screen, sort, and wash carefully.	Paraffined cups, glass jars, or enamel-lined cans.	Use a 50° Balling cold sirup to cover fruit.
Cranberries.....	Select ripe, well-colored berries, wash, and pack.	Paraffined cups, glass jars, or enamel-lined cans.	Use 50° Balling cold sirup to cover fruit.
Loganberries.....	Sort, wash, and pack.	Paraffined cups, glass jars, or enamel-lined tins.	Dry sugar 3 to 1 or 50° to 60° Balling cold sirup to cover fruit.
Raspberries..... (Black)	Sort, wash, and pack.	Paraffined cups, glass jars, or enamel-lined tin cans.	Dry sugar 3 to 1 or 40 to 50° Balling cold sirup to cover fruit.
Raspberries..... (Red)	Sort, wash, and pack.	Paraffined cups, glass jars, or enamel-lined tin cans.	Dry sugar 3 to 1 or 50° Balling cold sirup to cover fruit.
Strawberries.....	Cap, sort, and wash carefully.	Paraffined cups, glass jars, or enamel-lined tin cans.	Dry sugar 3 to 1 or 60° Balling cold sirup to cover fruit.
Youngberries.....	Sort and wash carefully.	Paraffined cups, glass jars, or enamel-lined tin cans.	Dry sugar 3 to 1 or 30 to 40° Balling cold sirup to cover fruit.
<i>Cherries</i>			
Cherries, black...	Stem, wash, and pack with or without pits.	Paraffined cups, glass jars, or enamel-lined cans. Vacuum pack improves the product.	Use a 50° Balling cold sirup to cover fruit.
Cherries, sour.....	Stem, wash, sort, pit, and pack.	Paraffined cups, glass jars, or enamel-lined cans.	Dry sugar 3 to 1 or a 60° Balling cold sirup to cover fruit.
Cherries, white...	Stem, wash, sort, and pack.	Paraffined cups, glass jars, plain tin cans.	Use 40 to 50° Balling cold sirup to cover fruit.
<i>Other fruits</i>			
Apricots.....	Avoid bruising; handle quickly; wash, halve, and pit.	Glass jars, or enamel-lined tin cans.	Use 40 or 50° Balling cold sirup and cover fruit.
Figs.....	Sort and wash carefully. Remove stem up to base of fig.	Paraffined cups, glass jars, or enamel-lined cans.	Use 35° Balling cold sirup or pack dry.
Grapes.....	Wash, stem, sort, and pack.	Enamel-lined tins or glass jars.	Use 40° Balling cold sirup to cover fruit.
Peaches.....	Peel, pit, halve or slice; pack promptly.	Enamel-lined tin cans or glass jars. Vacuum pack preferable.	Use 50° Balling cold sirup to cover fruit.
Prunes.....	Sort, wash, halve, and pit.	Enamel-lined tin cans or glass jars.	Use a 40 or 50° Balling cold sirup to cover fruit.

NOTE: Freezing temperatures of zero to 10 degrees above zero Fahrenheit have been found satisfactory for these products. Store at temperatures not in excess of 15 degrees above zero Fahrenheit.

*For more detailed information on packing, refer to text.

Table 2. FROZEN VEGETABLE PACK TABLE.*

Kind of vegetable	Method of preparation	Type of container	Method of packing
Asparagus.....	Sort, wash, and blanch 2 to 3 minutes in boiling water; chill and pack.	Parchment-lined waxed containers, tin cans, or glass jars.	Pack dry or cover with 2-per-cent brine.
Green and wax beans.....	Snip, sort, wash, blanch 2 to 3 minutes in boiling water; chill and pack.	Parchment-lined waxed containers, tin cans, or glass jars.	Pack dry or cover with 2-per-cent brine.
Lima beans.....	Shell, sort, blanch 2 to 3 minutes in boiling water; chill and pack.	Paraffined cups, glass jars, or tin cans.	Pack dry.
Broccoli.....	Use only tender stalks with compact heads. Cut back stems. Blanch 3 to 4 minutes in boiling water; chill and pack.	Parchment-lined waxed containers, tin cans, or glass jars.	Pack dry.
Cauliflower.....	Remove green leaves. Cut curds apart. Soak short time in weak brine. Blanch in boiling water 2 to 3 minutes and chill.	Parchment-lined waxed containers carefully packed to prevent moisture loss, tin cans, or glass jars.	Pack dry or cover with 2-per-cent brine.
Mushrooms.....	Use small buttons and wash carefully. Blanch 2 to 4 minutes and chill.	Pack in air-tight containers such as tin cans or glass jars.	Use 2 per cent brine although dry pack may be used.
Peas.....	Hull and blanch in boiling water for $\frac{1}{2}$ to $1\frac{1}{2}$ minutes; chill and pack.	Parchment-lined waxed boxes, glass jars, or tin cans.	Pack dry or cover with 2-per-cent brine.
Spinach.....	Sort the leaves, wash carefully, blanch 2 to $2\frac{1}{2}$ minutes in boiling water; chill.	Parchment-lined waxed boxes, glass jars, or plain tin cans.	Pack dry.
Sweet corn.....	Blanch corn with husks 6 minutes or 3 to 4 minutes without husks; pack either way.	Parchment-lined waxed boxes, glass jars, or tin cans.	Pack dry.

NOTE: Freezing temperatures of zero to 10 degrees above zero Fahrenheit have been found satisfactory for vegetables. Store at temperatures not in excess of 15 degrees above zero Fahrenheit.

*For more detailed information on packing, refer to text.

BIBLIOGRAPHY

"Microbiology of Frozen Foods," by Lawrence H. James, Fruit Products Journal, December, 1932.

"Temperature Changes in Foods," by M. A. Joslyn and G. L. Marsh. Fruit Products Journal, September, 1932.

"Suggestions for Freezing Foods," by H. C. Diehl, W. T. Pentzer, and J. A. Berry. Western Canner and Packer, September, 1934.

"Relation of Scalding Practice and Storage Temperature to Quality Retention in Frozen Pack Peas," by H. C. Diehl and J. A. Berry. American Society Horticultural Science, Vol. 30, 1933.

"Freezing Tests with Golden Bantam Corn on the Cob," by H. C. Diehl and J. A. Berry. Western Canner and Packer, April, 1933.

"Testing Frozen Fruits," by V. B. Bonney. The Glass Packer, July, 1930.

"Growth of Yeast Below Zero," by J. A. Berry. Science, Vol. 80-2076.

"Some Observations on the Behavior of Cured Ripe Mission Olives," by H. C. Diehl and J. A. Berry. American Society Horticultural Science, Vol. 30, 1933.

"The Frozen Pack Method of Preserving Berries," by Ernest H. Wiegand. Bulletin 278, Oregon Agricultural Experiment Station, 1931.